NASA SBIR/STTR Technologies

Z2.01-8489 - Variable Emissivity for Manned Spacecraft

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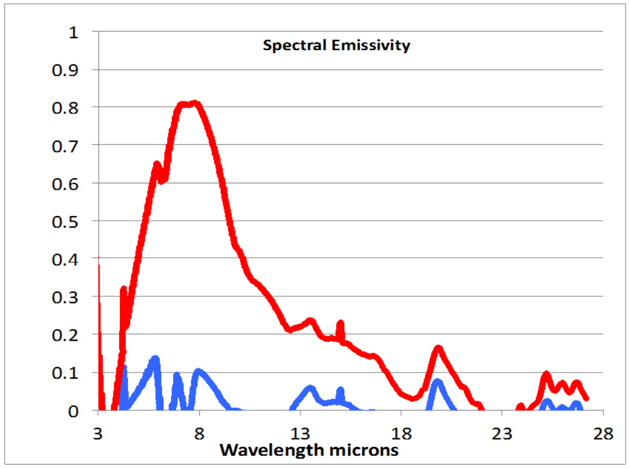
Identification and Significance of Innovation

Triton Systems is developing an unpowered, self-switching variable thermal radiance technology we call the Phase Change Thermochromic Radiator (PCTR) for active temperature control of spacecraft surfaces. PCTR automatically changes from low to high infrared emissivity above a designed temperature set-point, causing a surface in space to radiate heat only when it exceeds a critical temperature. The principle of operation involves a phase change compound integrated into a thin film multilayer, less than 2 µm thick. PCTR has advantages over competing approaches to dynamic emissivity such as electrochromics, in that it requires no electrical drive power, is relatively simple to fabricate, and contains only stable, rugged, well understood materials. The proposed program will develop a new generation PCTR with characteristics capable of meeting the demands of manned space vehicles, planetary probes and landers, including manufacturability in large areas, 10's of square meters.

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)



Technical Objectives and Work Plan

The overall goal of the Phase I and Phase II SBIR program will be to develop PCTR to meet the NASA roadmap performance goals for Variable Thermal Radiation. The program will demonstrate emissivity > 0.9 above the transition temperature, turndown ratios at least 6:1 and potentially as high as 10:1, and solar alpha 0.1 or less. The transition temperature will be engineered to 10°C by applying recent discoveries in processing of a novel material. In Phase I, a new microstructured element will be introduced into the design for enhanced emissivity. Three techniques will be compared and evaluated for fabrication of the microstructure and improvements measured for thermal performance and dynamic range. The new fabrication approaches will have potential for scaleup to produce the large areas required for planned missions, 10's of square meters. In addition to thermal performance, key qualification tests required for space applications include thermal cycling, vibration, peel tests, surface charge and life degradation would be completed. By the end of Phase II, TRL 5 is anticipated.

NASA Applications

Subject technology applies to the 2015 NASA Technology Roadmap, TA14, which call for thermal systems with reduced mass, reduced power requirements, enhanced performance, and increased reliability and survivability in hostile environments. Area 14.2 relates to Thermal Control Systems able to maintain vehicle surfaces and internals within an appropriate temperature range, and Sub-area 14.2 describes mid-temperature (-150 to 500°C) Heat Rejection and Storage.

Non-NASA Applications

Defense applications of emittance control films will include satellites, thermal signature for ships, aircraft, UAVs and land vehicles. Commercial applications will be for thermophotovoltaics, and architectural energy control for roofs, windows and walls.

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